PRACTICAL APPROACH ON ALUMINIUM MATERIAL WELDS COMBINED WITH DIFFERENT METALS IN WELDING PROCESS

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Abstract:

Selection of welding parameters is very important to increase the weld strength. Friction stir welding parameters affect the weld strength of aluminum alloy and EN8, such as high strength welding products. The procedure involved the development of a series of tests and observation of the parameters that will be controlled during the welding process. After the tests were performed, the samples were prepared for chemical attack, which allowed observation of the penetration, weld area, and dilution. After that, mathematical models were developed that correlate the controllable welding parameters with the aforementioned bead parameters.

Keywords: EN8, AL1040, welding

1.0 Introduction:

Inadequate weld bead dimensions such as shallow depth of penetration may contribute to failure of a welded structure since penetration determines the stress carrying capacity of a welded joint. To avoid such occurrences the input or welding process variables which influence the weld bead penetration must therefore be properly selected and optimized to obtain an acceptable weld bead penetration and hence a high quality joint. To predict the effect of welding process variables on weld bead geometry and hence quality researchers have employed different techniques.

The continuous use of turbines causes their degradation due to the magnitude of water impact and cavitations. Currently, one of the main problems with cavitations issues in turbines is the associated cost of blade replacement. Therefore, one solution that may lower these costs is fixing the damaged blades. An alternative that partially addresses this issue is the process of material deposition via manual welding in the areas of the blades that are notoriously eroded and subsequent rectification of the blade geometry by grinding of the unnecessary added material.

Several methods for obtaining the desired weld bead have been proposed via models designed to correlate the input variables with the output variables. The most frequently used method for determining process models is experimental design and regression analysis,4 and fractional factorial techniques have been used to

estimate the weld bead dimensions in automatic submerged arc welding.

2.0 LITERATURE REVIEW

[1] **Sonntag, Borgnakke, Van Wylen 2003.** Fundamentals of Thermodynamics Sixth Edition. New Jersey: John Wiley & Sons, Inc. A steady-state heat exchanger consists of a fluid flowing through a pipe or system of pipes, where heat is transferred from one fluid to another. Heat exchangers are very common in everyday life and can be found almost anywhere. Some common examples of heat exchangers are air conditioners, automobile radiators, and a hot water heater.

[2] **Q. Yu, A.Straatman, and B. Thompson,** "Carbon-Foam Finned Tubes in Air-Water Heat Exchangers," In current radiator designs, the largest thermal resistance is caused by the convective heat transfer (Rconv) that is associated with the air. This comprises of over 75% of the total thermal resistance. The second largest thermal resistance is caused by the convection that is associated with the fluid. Together, these resistances comprise of over 97% of the total thermal resistance. Since there is a large thermal resistance associated with the air, the increased heat transfer. cannot be observed. Therefore, there is a need to design a radiator that reduces the percentage of thermal resistance associated with the air.

[3] **C. Harris, M. Despa, and K. Kelly, "December 2004.** When compared to several automobile radiators, the micro heat exchanger outperformed them in a couple of areas. One area was on a heat transfer rate to volume basis in which the micro heat exchanger was better by more than 300%. Another area was a heat transfer rate per mass basis. In this area, the micro heat exchanger showed improvement of about 200%. These improvements were achieved by limiting the flow to smaller channels which increased the surface area/volume ratio and reduced the convective thermal resistance associated with the solid/fluid interface. However, in this study, the automobile radiators did outperform the micro heat exchanger on a heat transfer rate per frontal area basis. Here, the micro heat exchanger showed a reduction of over 45%. However, it is possible to construct a micro heat exchanger that has the same heat transfer rate/frontal area as current automobile radiators by using a more conductive material and reducing the spacing between the fins.

[4] A. Joardar and A.Jacobi, "Impact of Leading Edge Delta-Wing Vortex Generators on the Thermal Performance of a Flat Tube, Louvered-Fin Compact Heat Exchanger, Some parameters that affected the performance of the vortex generators were angle of attack, aspect ratio, and the

ratio of vortex generator area to heat transfer area. With the use of the vortex generators, there was an increase in the convective heat transfer coefficient.

[5] Incropera, DeWitt, Bergman, Lavine 2007. Fundamentals of Heat and Mass Transfer Sixth Edition New Jersey: John Wiley & Sons, Inc. the dynamic viscosity of the water. In Eq. 9, *k* is the thermal conductivity of the water and *n* is equal to 0.3. This is because the surface of the tube is cooler than the mean fluid temperature of the fluid (344K). In both equations, all fluid properties were evaluated at the mean fluid temperature. Eq. 9 is valid because the total length of the tube divided by the diameter is greater than 10, which causes the flow to be fully developed

[6] Munson, Young, Okiishi 2006. Fundamentals of Fluid Mechanics, Fifth Edition New Jersey: John Wiley & Sons, Inc. Prior to any machining operations with the carbon foam, the end manifolds of the radiator must be formed and each aluminum tube cut to size. One side of each manifold will have a negative of the tube array in it so that once the tubes are inserted into the foam; the manifold can be welded to each tube ensuring a leak-proof enclosure. The manifold itself will be constructed from sheet aluminum bent in a break and welded at the seams. Hose fittings will be welded at appropriate points to allow fluid in and out of the radiator.

[7] Andrew P. Freedman, 'A Thermoelectric Generation Subsystem Model for Heat Recovery Simulations', Thesis, Rochester Institute of Technology An important unit less constant to evaluate the performance of thermoelectric materials is the thermoelectric figure of merit, ZT. It describes the effectiveness of a specific thermoelectric material in terms of its electrical and thermal material properties. The figure of merit is expressed as: ZT=T

[8]. T. Mukawa, Y. Goto, N. Sekine, Y.Ikeda, Development of a plastic intake manifold, JSAE Review 17 (1996) 51-57Its main role is to convey air in the engine cylinders in order to achieve an optimum combustion. In particular the AIM function includes the replacement of working fluid in each cylinder, its filling with filtered air and the reduction of the noise caused by pressure waves during the refilling and discharge phases. The component design key issue are a low weight, an adequate mechanical strength, the durability and as much as possible reduced overall size.

9. Lee J, Roessler L. Vibration welded composite intake manifolds design considerations and material selection criteria. Proceedings Society of Automotive Engineers International

Congress After polymer solidification, the over moulded core is melted out and re-used. The major disadvantages of the lost core moulding process are the high capital cost and the complexity associated with metal alloy processing. In contrast, the vibration welding technique provides automotive parts suppliers with a simpler and more robust manufacturing process with lower capital investment.

3.0 MATERIALS AND METHODS

Aluminium foam is lighter than dense aluminium (Al) and exhibits superior energy absorption and sound insulation properties therefore; it is expected to be used in components of automobiles and construction materials. Al foam is usually used as the core of composite materials by combining it with dense materials, such as in Al foam core sandwich panels and Al-foam-filled tubes owing to its low tensile and bending strengths. These composite materials are usually fabricated by bonding an Al foam core to a dense material using an adhesive. However, the use of an adhesive prevents these composite materials from being used at high temperatures decreases their recyclability and has raised considerable environmental concerns Metal bonding between Al foam and a dense metal without using an adhesive has been realized by clad bonding and friction stir welding (FSW) processes However, these processes are limited to the fabrication of flat sandwich panels, and little research on the fabrication of Al-foam-filled tubes with metal bonding has been reported

The independently controllable process parameters were identified based on their effects on the geometry of the weld bead, dilution, and penetration. These parameters are voltage (V), welding speed (S), swinging length (L), wire speed (W), and shielding gas flow rate (R).

Plates of 6 mm thickness were used as base metal. Plates were cut to 50 mm wide by 100 mm long pieces using a power hacksaw with a metal cutting blade. In order to obtain a good primary joint configuration, the plate edges were smoothed by milling machine. Also, the plates were secured in place using specially designed fixtures as shown in Figure 1. Steel tools with cylindrical pin profile and different shoulder diameter were utilized to produce the joints. From the previous literature, the main parameters that have a greater influence on the mechanical properties of aluminium joints are recognized as tool rotational speed, welding speed and tool angle.

Chemical Composition of Base Metal

Material	C	Mn	Si	S(Max)	P(max)	Cu
AI 1040	0.40	0.75	0.25	0.050	0.040	0.025

Input Parameters and There Range

Parameters	Welding voltage (V)	Welding current (A)	Wire speed m/Min	Gas flow rate I/min
Values	23-25	200-220	2.4-3.2	12-16

4.0 Results and Discussion:

The plates of AI1040 and EN8 were welded by using welding methods. The quality of the weld depends upon various factors likewise welding speed, voltage.

The data were collected for each tested specimen according to the previously described experimental design matrix. To measure the welding bead characteristics, the following processes were carried out on each one of the specimens: sectioning, polishing, etching, and profile tracing. Every specimen sample was analyzed to determine the penetration, area, dilution, width, and height of the beads

Base metal AL1040 before welding

Base metal EN8 before welding

Samples after weld al1040 with en8

Testing Samples of Base Material before Tensile, Yield Testing and Face and Bend Root Tests

Broken Test Samples after Yield, Tensile and Bend Tests

5.0 Conclusion:

The similar weld joint of AI 1040 and EN8 material was developed effectively with welding with selected range of input variable parameters. Have been identified the optimal parameters for maximize and minimize the strength of joint. The optimal parameters settings to achieve the maximum strength of the joint is: - welding pressure of 1.4 bar; - welding time of 1.2 sec.; - and, amplitude of the sonotrode of 85%.

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